

**Promoting research cooperation
in small and medium-sized companies**

“Indirect” Technology Programs of the German
Ministry of Economics and Labor (BMWA)

Gaithersburg/Maryland, March 11, 2003

**Presentation to the
“Advisory Committee**

Advanced Technology Program”

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Ministry for Economics and Labor (BMWA)

BMWA’s responsibilities: Technology Policy

- **Programs for small and medium-sized enterprises:**
 - **innovation financing (venture capital)**
 - **research cooperation (indirect: “technology-neutral”)†300 Mio. € in 2002 (?30 % of total R&D expenditure by BMWA)**
 - **technological consulting**
- **multimedia research (indirect-specific program)**
- **energy, aeronautics (direct/technology-specific program)**
- **technical infrastructure (PTB etc. ?NIST)**
- **Research Ministry (www.bmbf.de):** specific research programs (e.g. biotech), SME share: 320 mill. € (?30 % of 1 bill. €, total budget for research: ?6 bill. €)

Why not leave it to the Schumpeter pioneer?

1. Framework conditions and innovation-friendly environment is what matters most:

- Human capital and equity capital as a main barrier to realizing innovation projects in Germany
- Tax policy (innovation-friendly taxation, e.g. venture capital, treatment of losses carried forward)
- Opening up of markets (energy, postal services)
- Intellectual Property Rights (e.g. Community Patent, EU Directive on software patents, national support infrastructure)

Why not leave it to the Schumpeter pioneer?

2. Market failures/innovation system failures:

- **positive external effects** † supporting basic/pre-competitive research (on the basis of EU framework for R&D state aids)
- **disadvantages due to firm size and region** † special technology programs for SMEs; special assistance for eastern German firms
- **information asymmetries** † improving start-up financing (venture capital)
- **lack of incentives for technology transfer** † fostering linkages between public research and business

Why not leave it to the Schumpeter pioneer?

3. “Minimal consensus”:

- Avoiding distortions of R&D allocation (avoiding “picking winning technologies”)
- Supporting R&D infrastructures (which contribute to wide dissemination of research)/fostering R&D cooperation
- Optimizing business’s “willingness to pay” for publicly supported R&D
- Exploiting the potential of new R&D-intensive firms (increases competition, reduces market failure for young firms)

Main features of BMWA policy

- Fostering market-driven research of SMEs (“industry-led” projects) with “indirect”, flexible programs
- Strengthening innovative capacities and realizing learning-curve advantages for SMEs (avoiding “more of the same”, “leaving the losers”)
- Adjustment of support conditions, at the same time avoiding frequent changes of programs (“label effect”, positive example: ATP?)
- Reviewing cost-sharing arrangements (competitive tender procedures; increasing private share in costs)

German “Mittelstand”: Where do we stand?

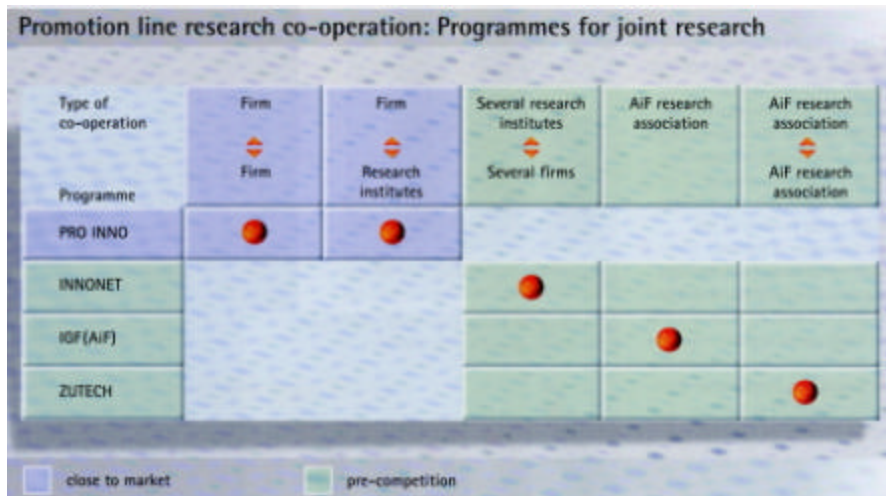
SMEs (?500 empl.) in Germany account for:

- 99 % of enterprises
- 60 % of employment
- 50 % of value added
- 43 % of turnover (in the private enterprise sector)

- “only” 18 % of R&D personnel
- “only” 12 % of R&D expenditures (total: 45 bill. €=1,8% GDP)

- but: increasing importance of small tech-firms
- large share of SMEs in “occasional research”

- in EU: high share of innovating firms in Germany (60 % of firms ?250 in manufacturing)



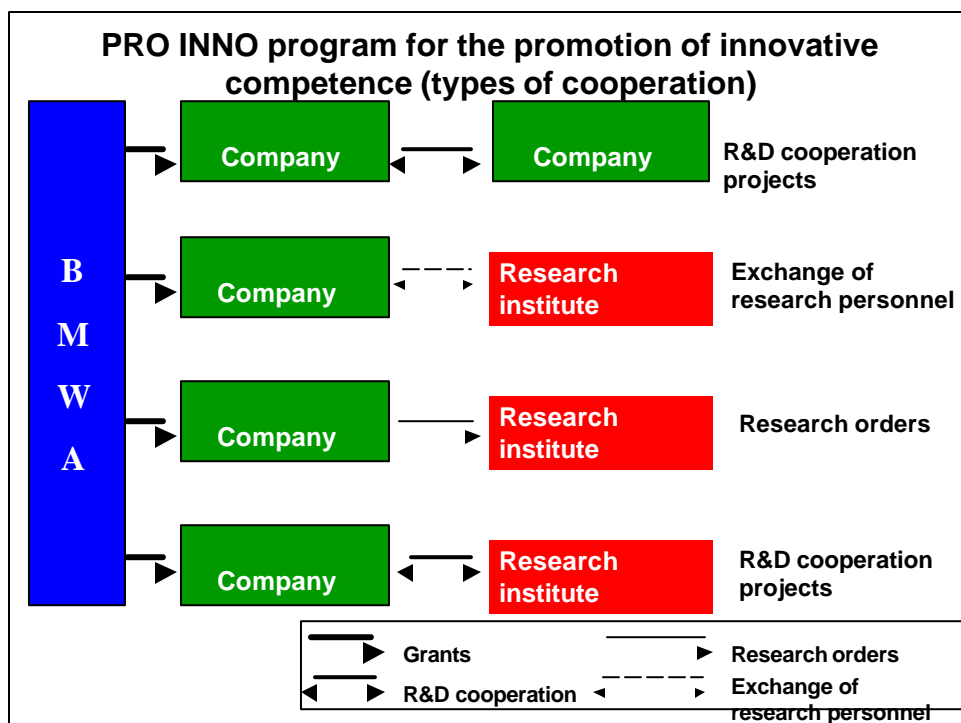
Similarities/dissimilarities to ATP:

PRO INNO: industry-led, technology-neutral, *continuous application*

InnoNet: competitive tender procedure, technology-neutral, *no grants* for firms

R&D Cooperation Support Program: PRO INNO

- projects close to market
- ?central feature: cooperation projects must involve a new innovation step for the firms concerned
?
 - increase in innovation competence
- grants to SMEs for
 - new national and transnational research cooperation (limit: 300,000 €/per firm)
 - the beginning of cooperation activities
 - exchange of personnel (limited to 125,000 €/firm)



R&D Cooperation Support Program: PRO INNO

- Type and nature of research:
 - physical/chemical technologies
 - measurement and control technology
 - information technologies
 - ?often: combination of cross-section technologies
- Industries:
 - medical eng. (incl. measurement, optical technologies)
 - machinery, techn. services
- Age of firms: ?5 years (40 %), 6-10 years (35 %)
- Size of firms: small: 77 % ? 50 employees
- Number of firms supported: 2,650 (1999-2001)

R&D Cooperation Support Program: PRO INNO

- Types of cooperation:
 - cooperation of companies: 41 %
 - cooperation firms/R&D institutions: 23.4 %
 - beginning of innovation activities (Einstiegsprojekte): 12.8 %
- Research institutions conducting the research:
 - universities (mainly: technical universities): 33 %
 - universities for applied research: 10 %
 - private research institutions: 38 %
 - Fraunhofer Society: 12 %
 - others (Max Planck Society, Helmholtz institutions etc.): 8 %

R&D Cooperation Support Program: PRO INNO

- Cost-sharing requirements:
 - nominal subsidy rate for firms: 35 % (according to EU framework: 25 % pre-competitive development + 10 % SME bonus)
 - preference for eastern German firms: + 10 %
 - effective subsidy rate: 25 % (due to lump-sum grants)
- Program awareness
 - only 5 % of firms that are supported by Federal Government's research programs report major problems in getting information on programs (study on behalf of BMBF)

R&D Cooperation Support Program: PRO INNO

- Project selection process:
 - submission of research proposals by firms and research institutions on a continuous basis
 - ranking of proposals by a “project management agency” (“Projekträger”), if necessary with the help of external experts
 - decision of BMWa on which proposals to fund (on the basis of recommendations of the “project management agency”)
 - approval rate: appr. 55 %

R&D Cooperation Support Program: PRO INNO

- Evaluation:
 - Evaluation of the “predecessor program” in 1998 (recommendation: new program should focus on “new innovation step”, “learning curve” advantages)
 - Reports of BMWA on specific topics (e.g. regional distribution of cooperation between firms and research institutions)
 - Evaluation of PRO INNO in 2002: impact of program on
 - new products/services, patents
 - improvement of innovation competence, entry into new technology fields
 - turnover, exports, employment, R&D staff (2 years after project)

R&D Cooperation Support Program: PRO INNO

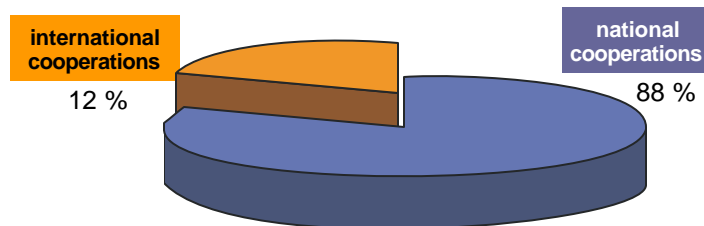
- Evaluation 2002 (survey: response rate 47 %):
 - impact on turnover (re-evaluation 2 years after end of project):
 - Ø turnover + 29 % (mainly due to new products)
 - impact on exports:
 - Ø exports + 93 % (in new States: + 127 %)
 - impact on employment (median: + 8,3 % after 2 years):
 - 78 % of firms: projects contribute to retaining jobs
 - more than 50 % firms: projects contribute to creating jobs
 - impact on R&D personnel:
 - turnover/firm ++: increase of 17 %
 - turnover/firm --: decrease of - 11 %

R&D Cooperation Support Program: PRO INNO

- **Refinements (in 2003/2004):**

- More flexibility: substituting “maximum subsidy level” for “limitation of projects” (thereby reducing incentive for larger projects [and: reducing disadvantage to western German firms which had qualified for predecessor program])
- Improving participation in transnational projects (special preference: + 10%)
- Quality control (“leaving the losers”)
- For all programs: Improving ex-ante coordination of evaluation research within BMWA (before commissioning evaluation). Objective: increasing the quality of evaluations (international state-of-art, stronger “say” of units not directly responsible for programs)

International cooperation projects PRO INNO



Western Europe: 89 projects = 26,7 %

Eastern Europe (incl. CIS): 192 projects = 57,6 %

USA/ Latin America/Asia: 52 projects = 15,6 %

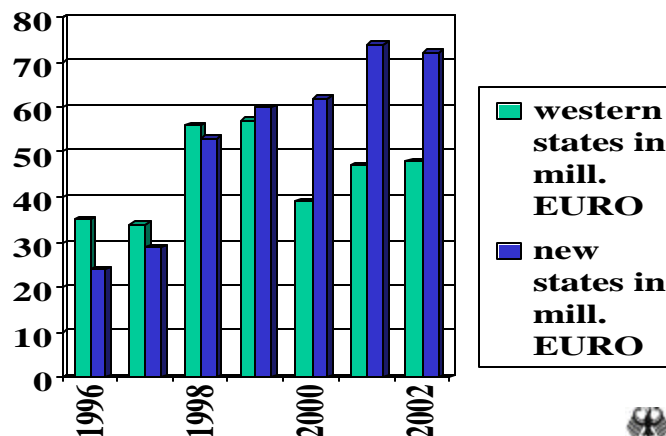
Most frequent partners: Russia/CIS, Switzerland, Austria,
USA (14 projects = 4%), China

Example international R&D cooperation PRO INNO

- **Cooperation: „Heidelberg Engineering Optische Meßsysteme GmbH“ + IRIDEX Corporation, California (leading provider of semiconductor-based medical laser systems)**
- Project 2001: diagnostic and therapeutic equipment for the treatment of age-related macular degeneration
- Objective: Supporting specialization in optical measurement systems for ophthalmology
- Heidelberg Engineering: founded 1990, 21 employees, sales 13 Mio. € (2000)
- IRIDEX: founded 1989, sales: \$33.4 mill. (2000)

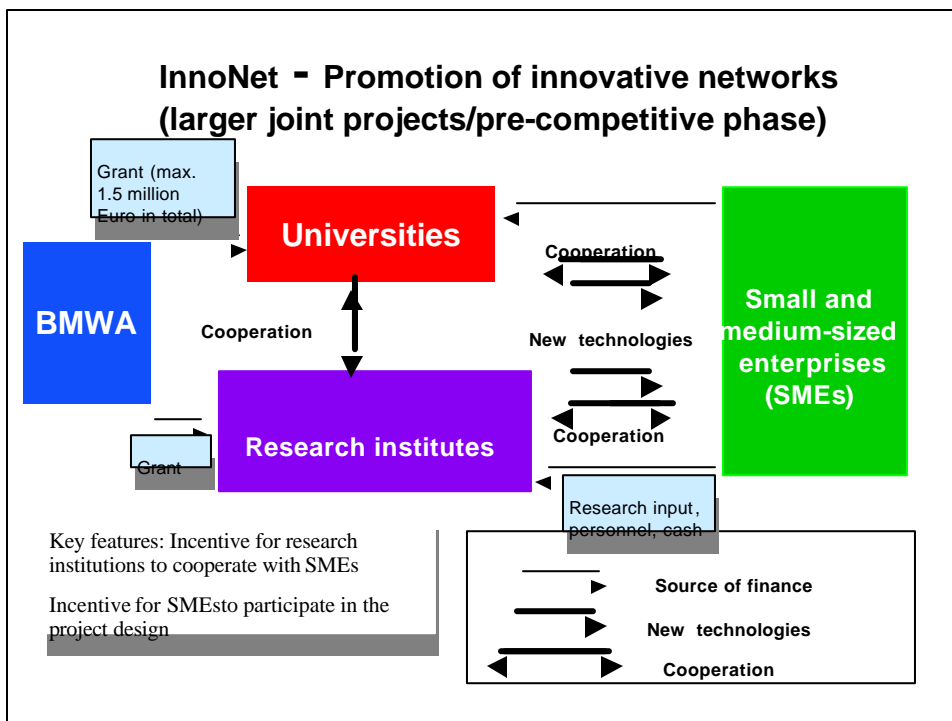
Cooperation Support Program: PRO INNO

promotes new innovation steps



R&D Cooperation Support Program: InnoNet

- Central objective:
 - **improving technology transfer to SMEs by providing incentives to research institutions to cooperate with SMEs**
- Central features:
 - **only research institutions receive funding, SMEs must pay 20 % of project costs of research institutions**
 - **cooperation: ?2 research institutions plus ? 4 SMEs**
 - **intellectual property rights stay with the “club” of cooperating partners (agreement on IPR-sharing required)**



R&D Cooperation Support Program: InnoNet

- Type and nature of research:
 - complex joint research projects (pre-competitive research, horizontal and vertical projects, higher technological risk)
- Industries:
 - medical eng., measurement, sensor techniques
 - information technology
 - machine tools, materials research
- Average number of SMEs/project: 6.4
- Average number of research inst./project: 2.5
- Average number of partners/project: 9.5
- Average financial volume/project: 1.2 million €

R&D Cooperation Support Program: InnoNet

- Size of firms: small: 65 % ? 50 employees
- Larger firms may participate as additional partners
- Number of firms involved: 320 SMEs
(+ 43 bigger firms + 126 research institutions)
- Research institutions conducting the research:
 - universities: 32 %
 - universities for applied research: 4 %
 - private research institutions: 37 %
 - Fraunhofer Society: 25 %

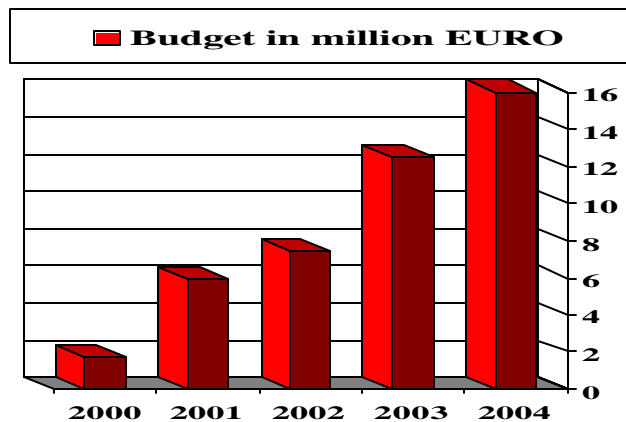
R&D Cooperation Support Program: InnoNet

- Cost-sharing requirements:
 - SMEs have to finance 20 % of total R&D expenditures (plus 15 % cash payment to research institutions)
 - subsidy rate for universities/research institutions: 780 % (effective subsidy rate: 756 %)
- Project selection process:
 - submission of proposals to “project management agency”
 - pre-selection and ranking of proposals by the agency (criteria: type of cooperation, innovative potential, commercial perspective, quality)
 - a panel (independent specialists from academia/industry) reviews and decides on proposals (joint meeting with BMWA)

R&D Cooperation Support Program: InnoNet

- Evaluation:
 - program started in September 1999
 - no ex-post evaluation yet, because projects are still running (projects last up to 3 years)
 - accompanying evaluation (Begleitforschung)
 - in-depth description and evaluation of types of cooperation projects (vertical/horizontal, high-risk/middle-risk)
 - organization of projects (e.g. active/passive partners)
 - evaluation of selection process (e.g. efficiency of panel)
 - first recommendations (e.g. reduction of cash payments)

Budget InnoNet

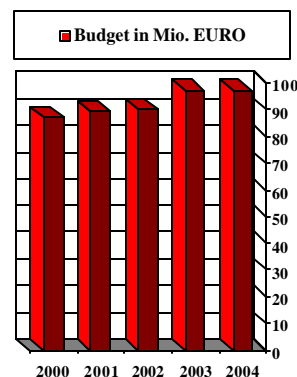


Joint Research (Industrielle Gemeinschaftsforschung IGF)

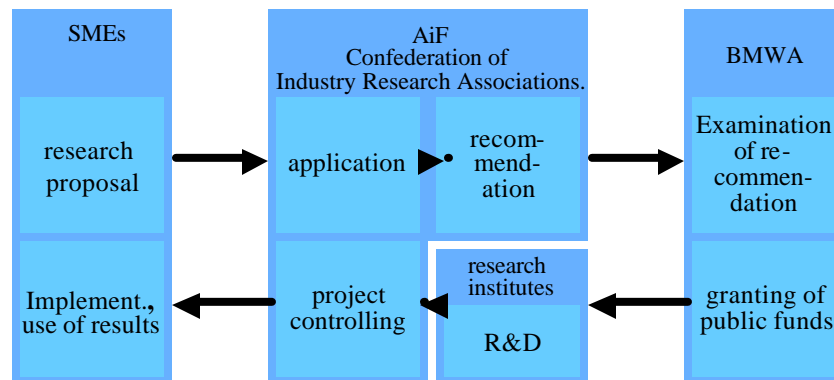
Objective: Stimulating research conducted by industrial research associations

matching grants for research associations to conduct pre-competitive research (open to all industries, actual emphasis on textiles, chemicals, plastics, food etc.)

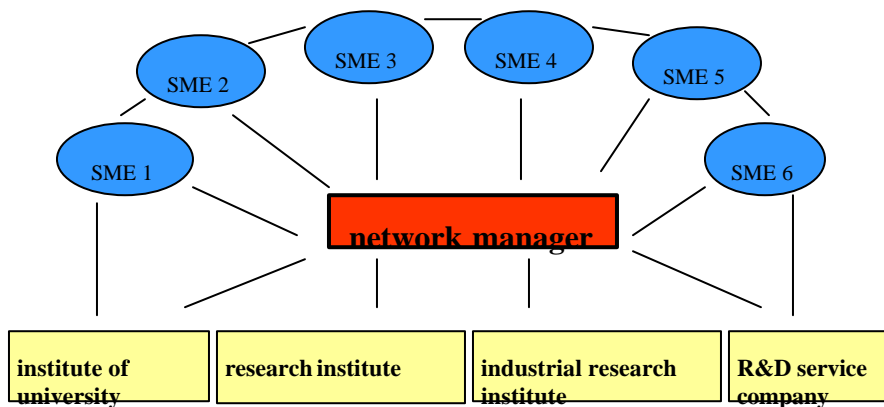
- obligation: wide dissemination of results
- research associations own intellectual property rights



Joint Industrial Research: How it works



BMWA program “Network management Eastern Germany (NEMO)”



goal:
strengthening regional potentials for competitiveness



Evaluation of research and technology programs/ infrastructure

Why is it so important? How is it done?

The aim:

- to gain knowledge and experience to improve operating and to design future research and technology policy programs or research institutions/infrastructure
- to get answers to more strategic questions about programme appropriateness

Forms of evaluation:

- ex ante: to define criteria for evaluation
- parallel: to improve the functioning of programmes/institutions
- ex post: to learn for the future

Evaluation standards:

- clear mandate
- independent expertise from academia & practice (including industry)
- international know-how (“look from outside”, independence)



Some examples of evaluation of research and technology policy in Germany

- **Effects of R&D schemes in New States, DIW/SÖSTRA 2001** (quantitative analysis of complementary vs. substitution effects [findings: positive effect on business financed R&D]; effect of R&D on competitiveness)
- **Effects of specific research programs of Federal Government, ZEW 2002** (complementary vs. substitution effects; matched samples-approach [findings: positive effect on business financed R&D]; 1 € ? 1,5-2 € add. priv. R&D expenditure)
- **System evaluation on „business-integrating research assistance“** (qualitative review of „program portfolio“, improvement of program design)

System Evaluation

“Business-integrating research assistance”

- Proposals made by independent Commission in December 2001
- Commission endorses need for specific SME-oriented support programs
- But: further refinement in 3 directions needed

- Basis for Implementation of Evaluation -

- (1) **More Transparency and User-Friendliness**
(harmonizing “small print” in guidelines; improving connection with other programs for innovation financing; merging programs into two promotion lines)
- (2) **Focus on SMEs (improving innovation competence)**
(participation of SMEs in generation of research topics in Industrial Joint Research (IGF); more flexibility for PRO INNO (fixed maximum subsidy level instead of limitation of projects))
- (3) **Concentrating scarce resources on SMEs with commercialization prospects** (“leaving the losers”)
(improved control of success; quality management, rating in SME; stronger competition for R&D projects in IGF system)

Implementation short-term, medium-term, long-term

Technological Consulting promotion line

... for application of new technologies in SMEs

- Consulting centers at chambers of crafts (Germany-wide network)
- Technology transfer centers in inter-company training facilities
- 24 regional centers of excellence for e-commerce
- 20 international R&D cooperation contact points

International R&D cooperation: 20 contact points



Technical infrastructure - measuring, standardization, testing, quality assurance

Federal Institute of Physics and Metrology (PTB)

Ensuring uniform weights and measures;
e.g. - time (atomic clock), scales
- gas, water and electricity meters

Federal Institute of Materials Research and Testing (BAM)

Promoting safety and reliability in chemical and materials technologies;
e.g. containers for hazardous goods,
reference materials for chemical analysis

Federal Institute for Geosciences and Natural Resources

Counseling the Federal Government
e.g. - long-term storage of radioactive waste,
- exploration of deposits and natural resources

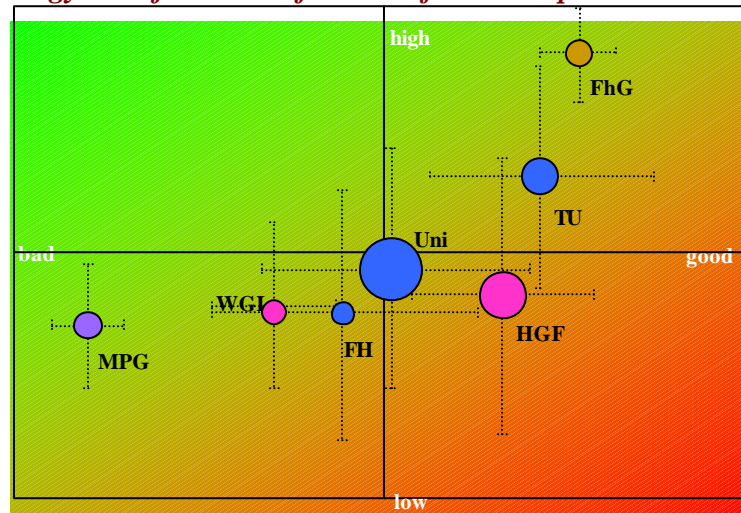
Federal Institute for standardization (DIN)

Self-regulated institution of German industry receiving governmental support

Setting standards

Technology transfer - Classification of German public research

Extent of transfer activities with the private sector
(Private sector as base for content-based orientation of research, interaction with private sector, mobility of staff towards private sector, third-party funds from private sector)

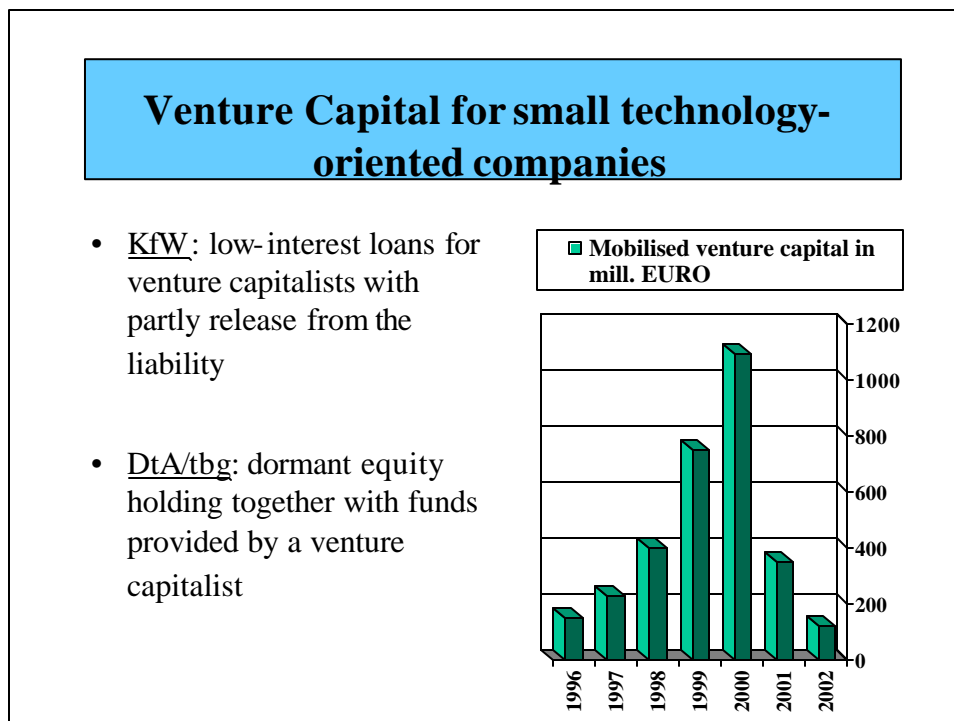
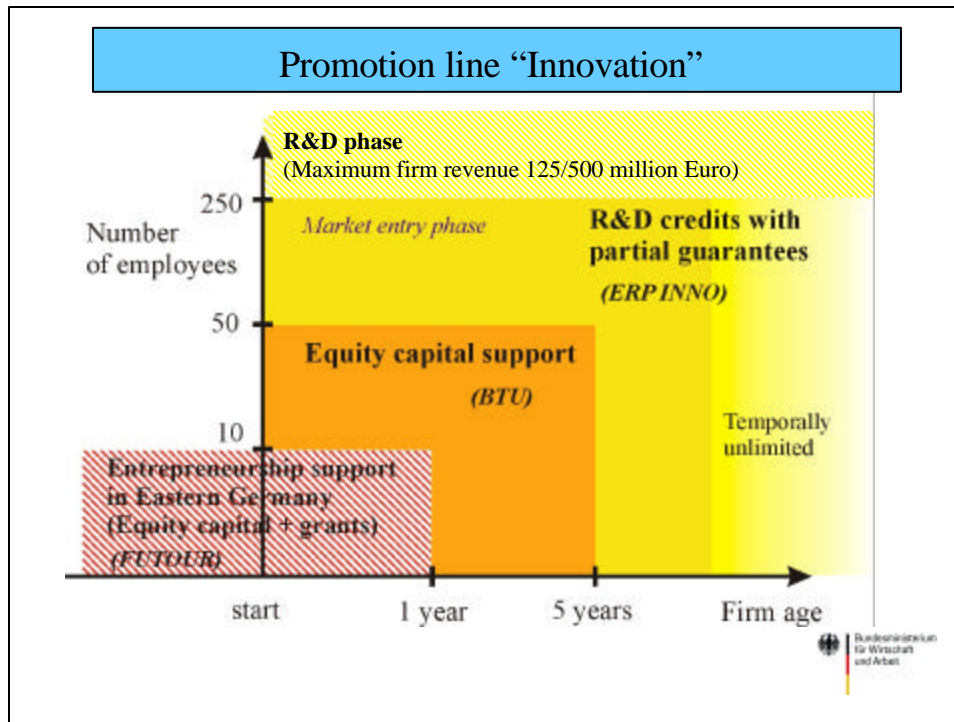


Pre-conditions for transfer activities with the private sector

(Orientation of research, funding situation, technological orientation, pattern of staff skills, size of research units)

Note: The size of the circles reflects the **number of R&D-employees** in the individual institutions. The dotted lines show the degree of heterogeneity of research institutions of a certain "type" (standard deviation of mean value).

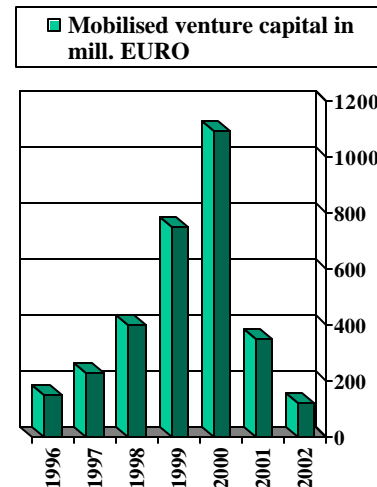
Source: ZEW (2000): survey on interaction between science and industry, 2000; for computation method see Schmoch et al. (2000): Wissens- und Technologietransfer in Deutschland. Stuttgart: IRB-Verlag



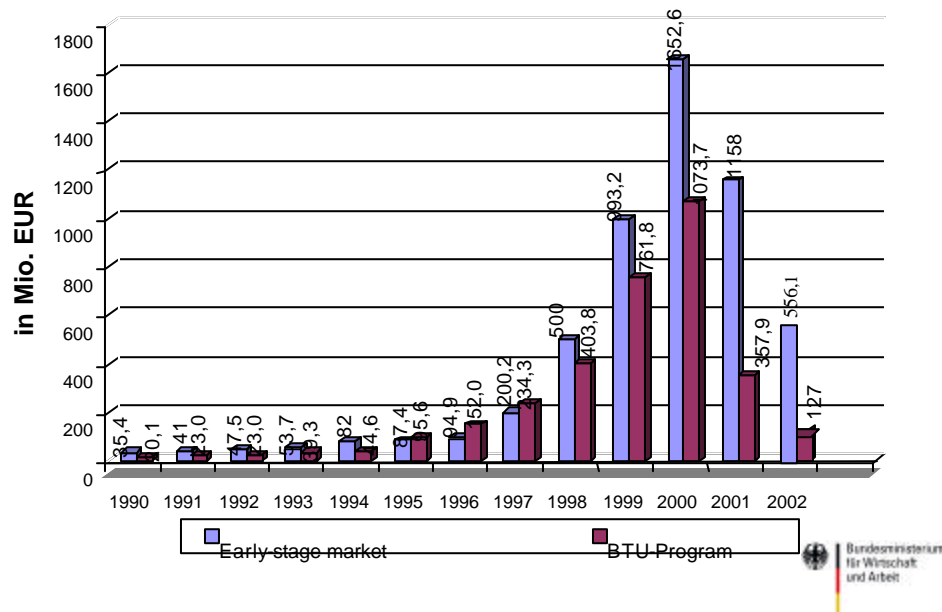
Venture Capital for small technology-oriented companies (BTU)

? Central feature: partial reduction of liability of VC-firms

- Changes for BTU:
 - „BTU-Seed“
 - **spring 2003:** ongoing negotiations to set up a new public-private fund to support follow-up financing of early-stage firms



Development of early-stage VC and BTU-program



BTU-Seed

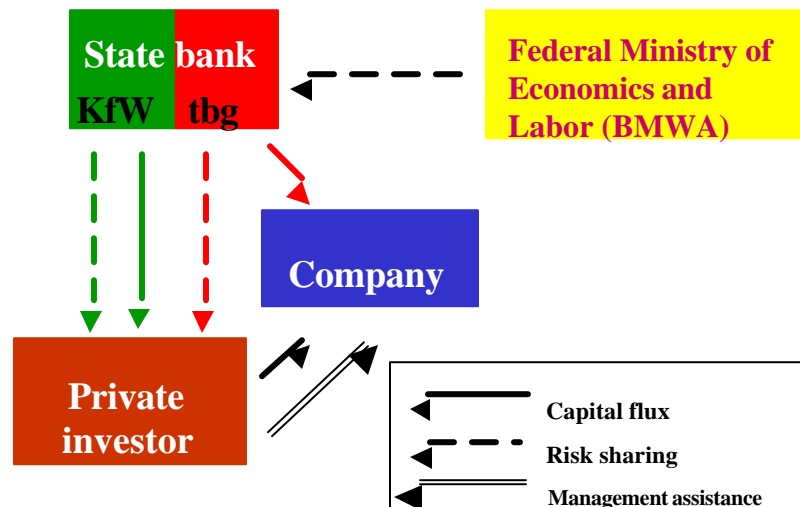
Objective: Stimulating the „seed“-phase of innovative start-ups

Equity capital (Mezzaninecapital/dividend-right certificate)

- up to 150.000 €per project
- financing of
 - business plans
 - consulting services

In 2002: „only“ 36 start-ups supported

Equity Capital for Small High-tech firms (BTU) - How it works -

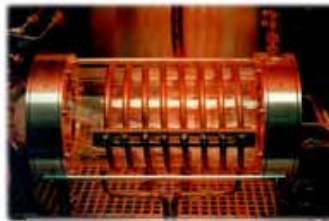


Example for TOU-program (now: BTU)

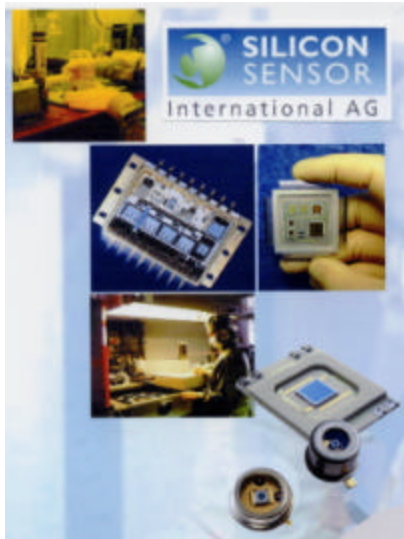
- first established in 1983 (IPO: 1997)
- leading manufacturer of state-of-the-art MOCVD equipment for the production of compound semiconductors
- headquarters: Aachen (North Rhine - Westph.), supported by TOU

AIXTRON

2002:
155 Mio. €turnover
450 employees
25 mill. €net income



Example for BTU-program



- Headquarters: Berlin
- profile: optical sensors
- first established in 1991

- high growth rates
- turnover 2002: 12 Mio. €
- 110 employees



Ministry of Education and Research (BMBF)

Responsibilities

- Education policy (with Länder)
- Research institutions (Max-Planck-Society, DFG, HGF Fraunhofer-Society, WGL)
- Thematic research (BioTech/life sciences, IT, space etc.)
- International R & D cooperation (EU, multilateral, bilateral - WTZ -)



Education: promoting entrepreneurship

- Curricula at school
- Partnerships of schools with industry
- Teaching of entrepreneurs at universities (honorary professorship)
- Special professorships for entrepreneurship at universities (e.g. sponsored by state banks and industry)



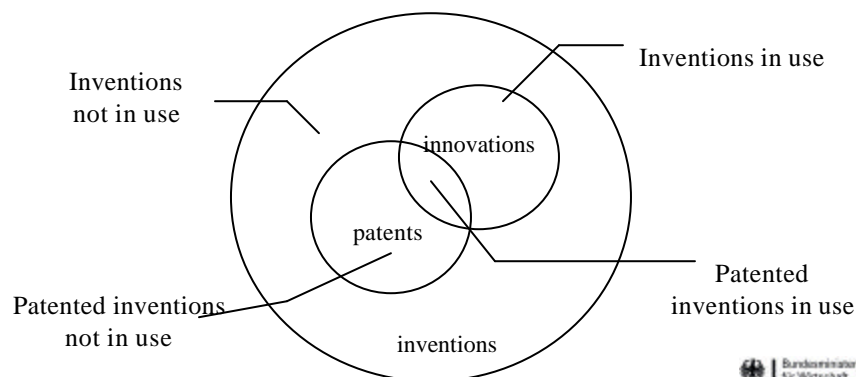
Public research institutions/universities

- To enable them to play their part in innovation, government has to promote the idea of commercial exploitation of know-how and research results (e.g. encouraging start-ups in large-scale facilities)
- Improve efficiency, especially by introducing output-oriented funding mechanism (e.g. linking public funding to orders from business, giving additional money to co-operation projects)
- Support the commercialisation of intellectual property rights (e.g. professional infrastructure)



Secure efficient IPR protection - but don't overestimate patents as an economic indicator

“In the desert of data, patent statistics loom up as a mirage of wonderful plenitude and objectivity” (Z. Griliches)



Support for business start-ups from universities/research institutes

The aim of the EXIST programme:

- Improve the start-up climate at universities
- Increase the motivation and skills of start-up entrepreneurs
- Support regional networks linking universities to firms, technology and start-up centres, banks, business consultants, chambers of industry and commerce, municipal administrations



“ ... the evolutionary policy maker is far more concerned to influence process than to impose predetermined outcomes, ... in short, technology policy should focus on co-evolving technological and market environments, not upon individual innovation.”

Stan Metcalfe, The Economic Foundation of Technology Policy: Equilibrium and Evolutionary Perspectives
in: Paul Stoneman, Handbook of the Economics of Innovation and Technological Change, Oxford: Blackwell 1995.

